BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Navy's F/A-18 Expected To Be An Effective Performer But Problems Still Face The Program

F/A-18 naval strike fighter development is near completion. Development flight testing, which will end in the spring of 1982, shows that the F/A-18 will meet most of the design performance goals, and it is expected to effectively perform its fighter and light attack missions.

Several logistics support issues gain importance as the F/A-18 program transitions from development to production and deployment. These issues include delay in developing pilot trainers and their lack of essential capabilities, delay in automatic testing equipment for operational units, and inadequate spares support.

F/A-18 cost increases continue as a major program issue. GAO anticipates additional program cost growth resulting from underestimated escalation and prime and subcontractor cost increases. While the Navy projected major cost reductions in several areas, significant hard savings have not yet been realized. GAO proposes several additional cost reduction areas which, if accepted, could result in substantial savings.

MASAD-82-20
FEBRUARY 26, 1982

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

NAVY'S F/A-18 EXPECTED TO BE AN EFFECTIVE PERFORMER BUT PROBLEMS STILL FACE THE PROGRAM

D I G E S T

The F/A-18 naval strike fighter is a multi-mission, carrier-suitable aircraft. This twin-engine aircraft will be used by the Navy and the Marine Corps for fighter and light attack missions such as strike escort, fleet air defense, interdiction, and close air support.

The Navy is concentrating on initial training, logistics, and support activities as the F/A-18 development program nears completion. All 9 pilot production aircraft have been delivered to the Navy as well as the first 4 of 25 limited production aircraft. Five aircraft were sent to the initial F/A-18 squadron which will begin training F/A-18 pilots and mechanics beginning in July 1982. The first class will be mostly Marine Corps personnel in preparation for the December 1982 initial operation capability, when the first Marine Corps F/A-18 squadron receives its full complement of aircraft.

The final major milestone, production decision for attack application, is scheduled for the fall of 1982.

At September 30, 1981, program cost to develop and build 1,377 F/A-18s was estimated at $35.3 billion. A $2.6 billion decrease during the past year resulted from lowered projected escalation rates.

WHY THIS REVIEW WAS MADE

GAO reviewed this program to provide the Congress a report on the status of the F/A-18 development. Emphasis was given to existing and potential problems related to the F/A-18 weapon system.

FINDINGS

GAO identified several areas of the logistics support for the F/A-18 that could adversely impact effective maintenance support and operational use of the aircraft. These included:

--F/A-18 pilot training device contractors lack necessary hardware and data to complete development on schedule. Delays in having the trainers available and operational means more flight time in the aircraft to offset the lack of trainer time. (See pp. 5 to 8.)

--The pilot training device designed to simulate combat situations will simulate only air-to-air activity. Air-to-ground and electronic counter-countermeasures simulations were deleted from the trainer's design. Lack of simulator capability means more flight time in the aircraft and/or a lack of training experience. (See pp. 8 and 9.)

--Development problems have caused schedule delays in automatic testing equipment, including essential test program sets. Failure to field this equipment on time means less repair capability and the need for more spares. (See pp. 9 and 10.)

During the past year, several Navy tests measured the operational suitability of the F/A-18. Although these tests identified some deficiencies, the overall conclusion drawn was that the F/A-18, with deficiencies corrected, should be able to meet the Navy and the Marine Corps' mission requirements. (See pp. 14 and 15.)

Work to resolve technical problems nears completion. Test results indicate corrective actions have been effective for several major problems. Preliminary indications are that corrections to other problems resulted in some improvements, but partial deficiencies remain and actions to correct and test them are underway. The Navy plans to accept some deficiencies. (See pp. 16 to 22.)

The F/A-18's program cost, although reduced over the last year by the Navy, is of continuing concern. There are indications that program cost will increase. Likely contributors to the increase are continued use of lower than projected inflation rates and contractors' manufacturing hours continuing at higher than estimated levels. In an effort to counter rising program cost, the Navy identified cost reductions, but significant hard savings have not been realized to date. (See pp. 23 to 25.)

Other cost saving measures are available. Foreign sales of the F/A-18 have reduced the cost of the program. Also, GAO believes more competitive procurement, elimination of Board of Inspection and Survey Trials, and deletion of mission-essential equipment from training aircraft could reduce costs. (See pp. 25 to 28.)

RECOMMENDATIONS

GAO recommends that the Secretary of Defense direct the Navy to:

--Allocate aircraft hardware between production and trainer development and ensure transfer of flight control system data to permit timely trainer development.

--Incorporate both air-to-ground and electronic counter-countermeasures capability into the operational flight trainer as part of its current development.

--Preclude future reductions in F/A-18 operational readiness due to delayed automatic test equipment. The Navy should (1) evaluate the cost to accelerate development of automatic test equipment versus cost of additional spares to offset the lack of test capability, (2) select the most cost-effective alternative, and (3) budget to adequately support the selected course of action.

--Accelerate implementation of the Navy's proposed cost reduction initiatives, estimated to save $1.2 to $4.6 billion.

--Determine the value to be derived from Board of Inspection and Survey Trials. Unnecessary redundancy between the trials and testing already accomplished should be eliminated.

--Delete, to the extent possible, mission-essential equipment from training aircraft, thereby saving substantial procurement (as well as maintenance) cost. For example, if just 40 fewer radars were procured, the Navy could save $50 million.

--Implement competitive procurement of test program sets for an estimated savings of $70 million and explore other situations where competition could be used.

VIEWS OF AGENCY OFFICIALS

GAO did not request official written comments on this report because of the need to issue it in time for congressional consideration of this weapon system. GAO did, however, discuss a draft of this report with high level officials associated with the management of the program and they agreed with the facts presented. Their views are incorporated as appropriate. The Navy disagreed with our recommendation to delete, to the extent possible, mission-essential equipment from training aircraft. They felt such a recommendation would not be feasible or effective. GAO disagrees with the Navy's position. GAO believes the proposed concept is feasible and is supported by the Marine Corps' decision not to include mission-essential equipment on their Harrier trainer aircraft. (See p. 29.)

Contents

		Page
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Program status	1
	Program management	2
	Objective, scope, and methodology	3
	Views of program officials	4
2	SUPPORT EQUIPMENT DEVELOPMENT BEHIND SCHEDULE	5
	Training equipment delivery delays and reduced capabilities may affect pilot proficiency and require more flight training	5
	Delays and deferrals of test equipment may affect aircraft operation and support	9
	Potential shortage of spare parts for F/A-18	10
	Conclusions	11
	Recommendations	12
3	RECENT F/A-18 TESTING AND PILOT EXPERIENCES ARE ENCOURAGING	13
	Navy preliminary evaluation	13
	F/A-18 climatic test	13
	Initial operational test and evaluation results	14
	Pilot opinions on F/A-18 are favorable	15
	Conclusions	15
4	TECHNICAL PROBLEMS APPEAR TO BE UNDER CONTROL	16
	Technical problems which were resolved	16
	Technical problems requiring further testing	18
	Some technical deficiencies being accepted	21
	Conclusions	22
5	F/A-18 PROGRAM COST CONTINUES TO BE A CONCERN	23
	F/A-18 program cost	23
	F/A-18 cost reduction program	24
	Measures which have or could reduce cost	25
	Conclusions	28
	Recommendations	28
	Views of agency officials	29
APPENDIX		
I	Our prior reports on the F/A-18 program	30

ABBREVIATIONS

GAO	General Accounting Office
OMB	Office of Management and Budget

PHOTOGRAPH COURTESY OF F/A-18 PROJECT OFFICE

F/A-18 NAVAL STRIKE FIGHTER

CHAPTER 1

INTRODUCTION

The F/A-18 naval strike fighter is a multimission, carrier-suitable aircraft. This twin-engine aircraft is designed to replace the F-4 and A-7 currently used by the Navy and the Marine Corps. The F/A-18 will be used for fighter and light attack aircraft missions, such as strike escort, fleet air defense, interdiction, and close air support. The Navy also plans to develop a reconnaissance version of the aircraft to replace the RF-4 and RF-8.

The F/A-18 fighter and attack configurations are identical except for different external equipment or ordnance peculiar to their respective missions. The single configuration is expected to provide operational flexibility during combat and result in reduced life-cycle costs. The Sparrow air-to-air missile will be used on the F/A-18 fighter and attack missions. Equipment used on attack missions will include various conventional ordnance, antiradiation missiles (HARM), guided weapons (Maverick and Walleye), a forward-looking infrared sensor and laser spot tracker pod, and a strike camera. An internal 20-mm. gun and wingtip Sidewinders will be carried on all missions. The Navy also plans to use the Advanced Medium Range Air-to-Air Missile and Harpoon antiship missile on the F/A-18. Initial integration studies of these missiles are expected to begin during 1982.

The F/A-18 radar has air-to-air and air-to-ground capability for multimission operations. It is capable of providing a multitude of information to the pilot on command.

PROGRAM STATUS

The F/A-18 full-scale development program began in early 1976, and the first flight was made in November 1978. By November 1981 the Navy had received all 11 development aircraft, all 9 of the fiscal year 1979 pilot production aircraft, and 4 of the 25 fiscal year 1980 limited production aircraft. The initial Navy F/A-18 squadron was commissioned on November 13, 1980, and received its first aircraft in February 1981. The squadron will train Navy and Marine Corps attack and fighter pilots and will also train Navy and Marine Corps maintenance personnel. As of November 1981, the squadron had five F/A-18s which were being flown by squadron pilots to gain experience in the aircraft and to develop a training program. Similarly, maintenance personnel are getting experience and are developing training programs for their aspect of F/A-18 support. Navy plans call for the first training classes to begin in July 1982. These classes will consist mostly of Marine Corps pilots and maintenance personnel. Initial operational capability is scheduled for December 1982, when the first Marine Corps F/A-18 squadron receives its full complement of aircraft. The Navy's first F/A-18 carrier deployment is scheduled for 1985.

In its September 1981 F/A-18 Selected Acquisition Report, the Navy estimated program cost to develop and build 1,377 aircraft at $35.3 billion. This estimate is approximately $2.6 billion less than the $37.9 billion reported in the December 1980 Selected Acquisition Report. The primary reason for the decrease was due to the revised escalation estimates established by the new administration.

The full-scale development test program, approximately 90-percent complete, is scheduled to be completed in April 1982. By the end of November 1981, the F/A-18 had accumulated approximately 6,000 flight hours. A number of testing milestones were accomplished over the past year, including an Initial Operational Test and Evaluation, the fourth Navy Preliminary Evaluation, the climatic test, and one lifetime of fatigue testing. All milestones preliminary to the Defense Systems Acquisition Review Council III (attack version) 1/ have been met except for a final Navy Preliminary Evaluation, the Board of Inspection and Survey Trials, and an Operational Evaluation. The latter two are scheduled to be completed in July-August 1982 before the Defense Systems Acquisition Review Council review scheduled for the fall of 1982.

The Navy plans to add advanced systems to the F/A-18, such as the Airborne Self-Protection Jammer, Advanced Medium Range Air-to-Air Missile, and noncooperative target recognition capability, all of which should enhance the F/A-18's effectiveness. The self-protection jammer is the next generation countermeasures system designed to allow the F/A-18 to defend itself against enemy radar controlled missile systems. The new medium range air-to-air missile will provide the F/A-18 with the ability to launch a missile and leave the area, avoiding retaliation. The noncooperative target recognition capability should enable the pilot to identify enemy aircraft beyond visual range. Cost for the advanced systems is included in the F/A-18 program.

PROGRAM MANAGEMENT

The F/A-18 project manager at the Naval Air Systems Command in Washington, D.C., is responsible for all management and technical aspects of the program.

The McDonnell Douglas Corporation, St. Louis, Missouri, is the airframe prime contractor. McDonnell has overall weapon system performance and technical management responsibility. Major McDonnell subcontractors include

---

1/Defense Systems Acquisition Review Council III (attack version) will evaluate the readiness of the F/A-18 for full production as an attack aircraft.

--the Northrop Corporation, Hawthorne, California, which designed and is building the center and aft fuselage and vertical fins and supplies subsystems located in these sections and

--the Hughes Aircraft Company, Culver City, California, which developed and is producing the radar.

The General Electric Company, Lynn, Massachusetts, designed and is manufacturing the F404 engine. The development and production of the engine is being performed under a Navy contract. An associate contractors' agreement between McDonnell and General Electric provides the engine and airframe interface.

The F/A-18 is being flight tested at the Naval Air Test Center at Patuxent River, Maryland, and the first training squardron is located at Lemoore Naval Air Station, Lemoore, California. The Navy plans to conduct the Operational Test and Evaluation at Pt. Mugu Naval Air Station, California, and China Lake Naval Air Station, California.

OBJECTIVE, SCOPE, AND METHODOLOGY

The objective of our review was to provide the Congress information on the cost, schedule, technical, and operational performance status of the F/A-18 program for its use in reviewing the Navy's fiscal year 1983 budget request. We issued a report on the status of the program 1/ in 1981. (See app. I for a listing of our prior reports on the F/A-18 program.)

Our review this year specifically addressed (1) the progress made in resolving and correcting performance and technical problems discussed in our previous report or identified during this year's review, (2) the F/A-18's program cost, and (3) the logistics support for the F/A-18 aircraft.

We performed audit work at the F/A-18 project office and related Navy activities, located in large part within the Naval Air Systems Command. We also conducted work at McDonnell and held discussions with officials at Northrop and Hughes.

To obtain as much information as possible within the timeframe of our review, we conducted interviews with Office of the Secretary of Defense, Navy, and contractor officials at various organizational levels and obtained and reviewed status and test reports and briefing documents. We interviewed officials who examined specific technical problems facing the F/A-18 program and obtained their comments. We interviewed Navy officials at Navy Headquarters, the F/A-18 project office, the Naval Air Test

---

1/"F/A-18 Naval Strike Fighter: Progress Has Been Made But Problems and Concerns Continue" (MASAD-81-3, Feb. 18, 1981).

Center, the Operational Test and Evaluation Force Headquarters, Lemoore Naval Air Station, and Pt. Mugu Naval Air Station. We also interviewed pilots with F/A-18 flight experience at both the training squadron and Operational Test and Evaluation Force.

Our review was performed in accordance with our standards for audits of governmental organizations, program activities, and functions.

VIEWS OF PROGRAM OFFICIALS

We did not request official written comments on this report because of the need to issue it in time for congressional consideration of this weapon system. We did, however, discuss a draft of this report with high level officials associated with management of the program. Their views were considered in completing this report and they agreed with the facts presented in this report. Their views are incorporated as appropriate.

CHAPTER 2

SUPPORT EQUIPMENT DEVELOPMENT BEHIND SCHEDULE

We identified several areas of the logistics support program that could adversely impact effective operational use and maintenance support of the F/A-18 aircraft. In the first instance, development delays and performance reductions in training devices will affect training of the first F/A-18 operational pilots. Further, maintenance support will be jeopardized by late delivery of automatic radar and avionics test equipment. The Navy could offset the delays through additional spares; however, the Navy is funding spares at less than prime contractor-recommended levels.

TRAINING EQUIPMENT DELIVERY DELAYS AND REDUCED CAPABILITIES MAY AFFECT PILOT PROFICIENCY AND REQUIRE MORE FLIGHT TRAINING

The F/A-18 training package includes the use of training devices to conduct initial and follow-on proficiency training. Among these are three types of pilot training devices--a part task trainer, an operational flight trainer, and a weapons tactics trainer. The Navy plans to spend over $255 million for F/A-18 pilot training devices.

The part task trainer is designed to orient and familiarize the student pilot with the hands-on-throttle-and-stick controls and with limited radar intercept geometry. The operational flight trainer is designed to provide training in development of pilot skills and techniques to efficiently and effectively fly the aircraft. This training includes cockpit procedures, system familiarization, development of operational skills and techniques, navigation, and emergency operation of the aircraft. The weapons tactics trainer is designed to provide combat training. It was expected to have the capability to simulate the operational environment the pilot will encounter during air-to-air and air-to-ground combat--weapons delivery, defensive electronic countermeasures, radar operation, and electronic counter-countermeasures. Weapons tactics training is accomplished by using a visual computer-generated image projected onto a domed structure.

An objective of the training program is to provide properly trained pilots to effectively operate the aircraft in carrying out assigned missions. Training devices, or simulators, are often the most economical and effective way of accomplishing some aspects of training. However, all three of the F/A-18 pilot training devices will be delivered from 4 to 7 months late, according to the Navy's schedule. Also, the major training device, designed to simulate combat situations, will simulate only air-to-air activity. Air-to-ground simulation as well as electronic countermeasure and electronic counter-countermeasure capability were deleted from the trainer's design. Consequently, pilots will have to fly additional air-to-ground missions to gain the appropriate

air-to-ground proficiency. According to Secretary of Defense and Navy officials, inflight training of pilots in an electronic countermeasure and/or electronic counter-countermeasure environment is neither effective nor economical. Without electronic countermeasure and electronic counter-countermeasure trainer instruction, a pilot may not receive adequate training in these areas. Navy officials stated that although training may initially be limited, they feel that limitations will be minimal because the first F/A-18 pilots trained will be fleet pilots experienced in operating fighter and/or attack aircraft.

F/A-18 training devices late

The F/A-18 trainer device contractors are experiencing difficulties in developing their various simulators, and this is resulting in schedule delays. The primary problem is that they cannot obtain needed aircraft hardware and aircraft data. These problems, if not rapidly corrected, will impair meeting the scheduled dates simulators are to be online for training.

Trainer device contractors point to the F/A-18 development prime contractor, McDonnell, as the cause of their problems. The trainer contractors are expected to purchase aircraft production equipment through the prime contractor. However, McDonnell experienced problems with some of its suppliers who were not meeting their production schedules. Suppliers' delivery problems resulted in equipment, such as multipurpose display units, head-up display units, control set assembly, and flight control electronic sets, being in short supply.

For example, the vendor for the multipurpose display and head-up display units experienced problems with testing, failing parts, and incorporating engineering changes. The vendor's production output, so far, has been insufficient to support aircraft, spares, and trainer requirements. McDonnell ordered 90 units--65 multipurpose displays and 25 head-up displays--for the 25 limited production aircraft. As of September 30, 1981, the vendor was scheduled to deliver a total of 72 units; however, actual deliveries totaled only 28 units. According to McDonnell, the vendor anticipates delivering all 90 units by May 15, 1982.

The flight control electronic set is another piece of equipment in short supply. The hardware configuration and programmable read-only memory sets currently available to the trainer device contractors vary significantly from production aircraft equipment. According to McDonnell officials, the flight control electronic set has undergone numerous changes, making it difficult to maintain the established schedule.

McDonnell blames part of the equipment delays on the trainer device contractors. McDonnell contends that delivery dates were not met because trainer device contractors did not allow sufficient lead-times in their purchase orders. For example, one contractor

issued a purchase order requiring delivery in 9 to 10 months on a piece of equipment that had a leadtime of 24 months.

McDonnell hoped to offset the leadtime problem by borrowing production line equipment, furnishing it to the trainer device contractors, and then replacing it as the ordered equipment for the trainers arrived. However, some suppliers experienced difficulties in meeting production equipment delivery schedules. Thus, the prime contractor's plan to borrow from the production line could not be done without disrupting the aircraft production schedule.

To offset the hardware problem, the Navy loaned some full-scale development hardware to the trainer device contractors so that the design and development efforts could proceed. These components were in short supply and varied in configuration from production hardware. Trainer device contractors were able to use the full-scale development components for systems design and development but not for systems integration. The contractors claimed that the full-scale development items were not compatible with the other hardware and could not be used with production hardware to make a complete unit.

In addition to hardware delays, the trainer device contractors had difficulty in obtaining flight control system data in a usable format. The prime contractor, the source of flight control system data, was to provide only limited information until the "physical configuration audit aircraft" 1/ was delivered to the Navy. However, the physical configuration audit aircraft scheduled to be delivered at the end of July 1981 was not delivered until mid-September, about a month and a half behind schedule. The lack of complete and current data posed problems for the trainer device contractors in continuing their design efforts. Prime contractor officials pointed out that the rapidly changing aspects of the flight control system also contributed to data delays.

According to Navy and contractor officials, an agreement has been reached whereby the prime contractor will provide data to the trainer device contractors and will assist them in integrating the data into the trainers.

Delivery delays may affect pilot training

Due to the difficulties experienced by the contractors in obtaining hardware and data, the scheduled delivery dates for the trainers will not be met. The scheduled delivery dates for the trainers are shown in the table on the following page.

1/Physical configuration audit aircraft was the aircraft on which all approved changes to a specific date were made and verified.

Trainers	Scheduled delivery dates	Current est. delivery dates	Delivery delays
Part task trainer	9/81	4/82	7 months
Operational flight trainer	12/81	4/82	4 months
Weapon tactics trainer	3/82	9/82	6 months

In addition, installation times of 3 to 6 months will be required to make the trainers operational before training can commence.

The Navy determined that of the three trainers, timely delivery of the operational flight trainer is of highest priority. The operational flight trainer is needed for training of the first transition squadron to proceed as scheduled. Flight training is scheduled to commence in July 1982. However, as a result of our discussions with Navy and contractor officials, it is our opinion that the delivery schedules are overly optimistic.

If the scheduled delivery dates for the various trainers are not met, flight training could be affected. However, according to Navy officials, training will not necessarily be adversely affected if the trainers are not available. Instead, F/A-18 replacement pilots will increase their time in the aircraft to offset the lack of trainer time. In our opinion, this negates the purpose of having trainers. The trainers are intended to provide the pilots the opportunity to develop skills and techniques without incurring the high costs and the inherent hazards associated with flying the aircraft.

Weapons tactics trainer capabilities presently limited

The weapons tactics trainers currently under contract will have the capability for training the air-to-air mission role but not the air-to-ground role. The original system design specification called for a trainer providing training in air combat maneuvering, weapons delivery, radar imagery, and normal emergency procedures. Also, the specifications included provisions for full air-to-ground weapons delivery and electronic counter-countermeasures systems.

The Navy plans to incorporate the air-to-ground and electronic counter-countermeasure capabilities into the weapons tactics trainer in the fiscal year 1983 purchase. Navy officials said they are currently pushing the state of the art in visual system technology and that development of the air-to-ground mode will depend upon the development of an improved visual system.

Development effort is also needed to integrate the F/A-18's ground attack radar modes. Further, according to Navy officials, all air-to-ground aircraft radar modes must be completed before the electronic counter-countermeasures simulations can be developed.

Presently, the weapons tactics trainer does not have air-to-ground or electronic counter-countermeasure capabilities. According to a Navy official, the only effective way to train pilots for electronic counter-countermeasures is in a trainer. Since inflight training facilities are limited for this type of training, it seems essential that trainer capabilities be developed as soon as possible.

Navy officials said that they are looking at adding the air-to-ground simulation to the operational flight trainer.

DELAYS AND DEFERRALS OF TEST EQUIPMENT MAY AFFECT AIRCRAFT OPERATION AND SUPPORT

The Navy's ability to support the F/A-18 may be affected by reduced testing capabilities. This could happen because development of software programs for testing the radar and other avionics equipment was deferred.

The avionics test set, radar test set, and hybrid test set are the primary equipment items used for testing various avionics and radar components. The avionics and hybrid test sets are single port 1/ units while the radar test set is a dual port unit. The dual port capability allows constrained simultaneous testing of analog and digital components, whereas single port units can handle either analog or digital component testing on an item-by-item basis.

The development program for the avionics test set and radar test set experienced technical problems. Also, the development costs of these test sets increased significantly. (See p. 24.)

Technical problems with radar test set caused schedule delays

The radar test set contractor experienced problems in concurrently developing the analog and digital ports that make up the dual port test set. Due to development problems, plans were changed and the analog and digital ports were developed separately, followed by the software designed to connect them. This new design approach, however, resulted in revising the scheduled delivery date of the first production test set from January 1983 to March 1983. McDonnell and Navy officials believe the program is now progressing satisfactorily.

1/Port is the location where the aircraft component is connected to the automatic tester by means of the test program set.

Due to the technical problems and cost increases, the Navy is considering the use of a modified E-2C RADCOM test set as an alternative to the radar test set being developed for the F/A-18.

The Navy had not made a decision whether to use the radar test set or the modified E-2C RADCOM test set at the time we completed our review. The Navy is expected to make a decision in early 1983.

Deferral of test equipment in Navy plans affect operation

While there have been technical, schedule, and cost problems in the radar test set development program, even more of a problem may be the Navy's plans for fielding the equipment. The scheduled date the radar testing equipment is to begin supporting the first Marine Corps F/A-18 operational squadron is January 1984. This means that the Marine Corps will not have automatic radar testing equipment for over 1 year after the F/A-18 becomes operational in December 1982.

According to Navy officials, delivery of automatic test equipment to the Marine Corps 1 year after the first squadron becomes operational is the result of their planned support time frames rather than the results of developmental delays.

Test equipment requirements revised by Navy

Due to cost problems, the Navy, in April 1981, decided to revise the requirements for automatic test equipment and test program sets. Test program sets consist of hardware, software, and instructions which interface the unit under test with the test set. They control the testing procedures to isolate the faulty component.

The revision included deferring the development of test program sets for the more reliable avionics components. According to Navy and contractor officials, this deferral did not reduce the capability of the avionics test sets but it decreased the Navy's capability for shipboard testing. Navy and prime contractor officials said that high reliability projections, verified by reliability demonstrations, implied that increasing shipboard spares may be more cost effective than buying test program sets. Thus, procurement of additional spares for these aircraft equipment items would be required.

POTENTIAL SHORTAGE OF SPARE PARTS FOR F/A-18

Navy funding for spares appears to be considerably below their needs. We found that no funds for fiscal year 1981 long-lead spares had been budgeted except $11 million for attack peculiar spares. Further, the Navy funded fiscal year 1981

spares at less than contractor-recommended levels. Additional spares will be needed due to delays in automatic test equipment.

In comparing Navy fiscal year 1981 funding of spares to the levels recommended by McDonnell, we found a considerable variance. For fiscal year 1981 funding for long-lead spares, McDonnell had recommended a level of $94 million; yet the Navy only funded $11 million. Since this $11 million is devoted to attack peculiar spare items, the variance of $83 million results in no long-lead funding of spares for the aircraft itself. For fiscal year 1981 spares, McDonnell recommended $115 million, and the Navy budgeted $94 million resulting in a $21 million variance. These variances indicate even greater potential shortages when considering that McDonnell's spares funding recommendations preceded a Navy program change to reflect schedule delays in the development of automatic test equipment.

The Navy will need more spares as a result of delays in development and delivery of automatic test equipment. Aircraft repairable components were planned to be repaired at the intermediate maintenance level with the automatic test equipment. However, lacking the automatic test sets, the repairable components must go to the next maintenance level, depot level, for repair. As a result, the Navy projects an increase in components turnaround time from 7 days to about 60 days. Consequently, the spares pipeline must be increased substantially. A Navy official estimated a cost of over $150 million for the additional spares required during fiscal years 1982 through 1986.

The contractor believes failure of the Navy to adequately fund spares requirements may result in low operational readiness rates.

CONCLUSIONS

The F/A-18 pilot trainers and automatic test equipment and test program sets experienced technical difficulties which caused schedule delays. Delays in having the trainers available and operational means that pilots will have to increase their time in the aircraft to offset the lack of trainer time. If more flight hours than planned are incurred, the demand for spares will be higher than anticipated. Further, as a training device, the weapons tactics trainer is incomplete--lacking air-to-ground simulation as well as electronic counter-countermeasures capability.

Delays in having automatic test equipment will result in turnaround times for aircraft repairable components increasing from approximately 7 days to 60 days. As a result, additional spares support will be required. As the need for spares increased, the Navy's long-lead funding for spares decreased. The ultimate result of these divergent tracks can lead only to reduced F/A-18 readiness in the future.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct the Navy to

--allocate aircraft hardware between production and trainer development and ensure transfer of flight control system data to permit timely trainer development;

--incorporate both air-to-ground and electronic counter-countermeasures capability into the operational flight trainer as part of its current development; and

--preclude future reductions in F/A-18 operational readiness due to delayed automatic test equipment. The Navy should (1) evaluate the cost to accelerate development of automatic test equipment versus cost of additional spares to offset the lack of test capability, (2) select the most cost-effective alternative, and (3) budget to adequately support the selected course of action.

CHAPTER 3

RECENT F/A-18 TESTING AND PILOT EXPERIENCES ARE ENCOURAGING

Navy and contractor testing held during 1981 gives a measure of the operational suitability of the airplane. Major testing included a Navy preliminary evaluation, a climatic test, and an initial operational test and evaluation. While deficiencies were identified in all of the tests, the aircraft performed adequately and had the potential to meet the Navy and the Marine Corps' mission requirements. Discussions with Navy and Marine Corps pilots experienced in a number of combat aircraft confirmed the tests conclusions.

NAVY PRELIMINARY EVALUATION

A Navy preliminary evaluation was held in late 1980 to determine whether F/A-18 flight characteristics were affected by changes made to the airplane. The evaluation cited a number of performance problems, including deficient F/A-18 range and roll-rate performance (see p. 21 for discussion on range and p. 16 , on roll-rate performance) and insufficient single engine rate of climb. (See p. 21.)

Two reports were prepared on the Navy Preliminary Evaluation. One report, after evaluating the aircraft's performance against contract specifications, concluded that the F/A-18 had good effectiveness potential as a fighter and trainer aircraft but that it possessed limited potential as a fleet air defense and interdiction aircraft until deficiencies were corrected. The other report on the evaluation, however, concluded that the F/A-18 as a single pilot aircraft had limited potential as a fleet air defense fighter and as a trainer but very good potential as a fighter and interdiction aircraft. Both reports stated that correction of deficiencies would improve the F/A-18's mission effectiveness.

F/A-18 CLIMATIC TEST

The F/A-18 climatic test evaluated the operational suitability of the aircraft under a wide range of temperatures and weather conditions. The Navy reported that the F/A-18's climatic test was the most effective and comprehensive test ever conducted on a naval aircraft. All test objectives were accomplished in a single test period with relatively minor discrepancies being discovered. The test aircraft was subjected to extreme temperatures and was not equipped with any special equipment, seals, fuel, or fluids. According to Navy officials, the minor corrections required will be incorporated early in production. For example, the excessive time required to bring the flight control system

online during cold weather starts has been corrected and will be incorporated in the next flight control software change.

INITIAL OPERATIONAL TEST AND EVALUATION RESULTS

The initial operational evaluation assessed the potential operational effectiveness and suitability of the F/A-18 for the Navy and the Marine Corps' strike fighter missions. At the time of the test, the attack capability of the F/A-18 was not fully developed. Although all air-to-ground radar software modes were not completed, the Operational Test and Evaluation Force evaluated some air-to-ground capabilities as part of the fighter operations and identified some radar limitations. The effectiveness of F/A-18 attack capability is to be evaluated by the Navy in late 1982.

The initial operational test and evaluation considered the F/A-18's roll-rate to be deficient. However, none of the airplanes used in the evaluation had all of the modifications designed to improve roll-rate.

During the initial operational test and evaluation, the F/A-18 achieved a fully mission capable rate of 64 percent. This compares with the 80-percent goal for the F/A-18 at maturity. Navy officials believe that operational readiness will improve as the F/A-18 matures.

The F/A-18 did achieve a high level of reliability and maintainability during the initial operational test and evaluation. For reliability, the F/A-18 achieved a mean-flight-hours-between-failures of 2.37 hours, which was significantly better than the 1.4 hours criterion used for the evaluation. The F/A-18's reliability at 2.37 hours was much better than the current fleet mean-flight-hours-between-failures of approximately 1 hour for the F-4 and A-7 aircraft, which the F/A-18 is to replace.

Also, the maintainability of the F/A-18 during the initial operational test and evaluation was better than the 8-hour test criterion. The F/A-18 achieved a level of unscheduled direct maintenance staff-hours per flight hour of 6.1 hours. According to Navy officials, this equates to a total direct maintenance staff-hours per flight hour of less than 20 hours, which is a vast improvement over other fleet aircraft, such as the F-4 at 49 hours and the A-7E at 35 hours.

The Operational Test and Evaluation Force concluded that the F/A-18 has the potential to be

--operationally effective as a fighter,

--operationally effective as a trainer, and

--operationally carrier suitable.

PILOT OPINIONS ON F/A-18 ARE FAVORABLE

During our review we interviewed a number of Navy and Marine Corps pilots who had flown the F/A-18. Most of the pilots had previous flight experience in F-4s, F-14s, A-4s, A-6s, and/or A-7s. Overall, they found the F/A-18 to be a step forward in naval aircraft.

In contrasting the F/A-18 with existing Navy aircraft, the pilots felt the F/A-18 would be more effective and survivable. They noted that the better-than-anticipated accuracy of the inertial navigation system and the advanced ground attack radar modes should lead to better-than-required performance for the ground attack mission. They commented that the F-4's radar had practically no ground attack capability when it did work, which was seldom. The F/A-18's speed and maneuverability impressed A-7 pilots, particularly in the performance of close-air-support tactics.

The pilots acknowledged the complexity of the F/A-18 but felt this worthwhile considering the reduction in the pilot's workload. For example, in the F-4 the pilot must perform all bombing calculations--angle of attack, release point, and so forth. However, in the F/A-18 all calculations are made by the aircraft's computer while the pilot is making the attack. Consequently, the pilot can direct attention to flying the aircraft and avoiding enemy antiair defenses.

Fleet pilots may be even more favorably impressed by future F/A-18s. While the pilots were satisfied with the performance of the F/A-18s they flew, these were not production aircraft. None of the aircraft at that time had all modifications to correct performance shortfalls, such as roll-rate deficiency, and, of course, none had the final production flight control software.

CONCLUSIONS

Although various tests, including a Navy Preliminary Evaluation, climatic test, and an initial operational test and evaluation, identified a number of deficiencies, the overall conclusion drawn from these tests was that the F/A-18, with deficiencies corrected, should be able to meet the Navy and the Marine Corps' mission requirements.

The Navy and the Marine Corps pilots we interviewed found the F/A-18 to be an effective aircraft. Currently, fleet pilots are evaluating aircraft performance and developing optimum tactics for flying the aircraft.

CHAPTER 4

TECHNICAL PROBLEMS APPEAR TO BE UNDER CONTROL

During 1981 the Navy continued to work on technical problems identified in the test program. While some corrections of problems have undergone only initial testing and results of those tests are not conclusive, it appears that most major technical problems are under control or have been resolved. Test results indicate corrective actions have been effective for problems, such as the aircraft roll-rate, bulkhead failures, leaking fuel cells, and high oil temperatures. Preliminary indications are that corrections have been made to other problems, but some deficiencies remain and actions to correct and test them will continue. The Navy plans to accept some deficiencies. Consequently, for these no improvement plans are being considered.

TECHNICAL PROBLEMS WHICH WERE RESOLVED

Some of the technical problems we reported on in February 1981 (see app. I) are under control or resolved. Roll-rate performance and oil temperature are considered acceptable by the Navy. These and other technical problems for which corrective actions appear to be effective are discussed in this section.

Roll-rate performance

In February 1980, during a Navy Preliminary Evaluation, the Navy reported that the F/A-18's roll performance was inadequate. Flight test data showed that the aircraft failed to complete a 90-degree change in bank angle in the specified time and failed to achieve the specified sustained roll rate.

The problem was attributed to the flexibility of the outer wing panel combined with the excessive damping effect produced by the wing.

The following design changes were made in 1980 to correct the roll-rate problem:

--Increased the stiffness of the wings by adding more composite layers.

--Increased surface area of the ailerons.

--Incorporated differential trailing edge flaps.

These improvements were sufficient to meet the specification in most of the flight envelope. The only exception was in the low altitude transonic flight regime. In 1981 the contractor incorporated differential leading edge flaps to further improve roll-rate performance. Based on flight tests of aircraft with all changes incorporated, the F/A-18 roll-rate performance now meets specifications.

Bulkheads

Navy plans call for testing the F/A-18 to four design lifetimes. The F/A-18 design life is 6,000 hours; thus, the F/A-18 will undergo approximately 24,000 hours of fatigue testing.

Several fatigue failures occurred during the first life-cycle test that was completed on April 30, 1981. The most serious failure occurred early in the test at 328 hours to a wing-carry-through bulkhead. The latest failure to a bulkhead occurred at 5,543 hours and was considered by Navy officials to be minor, the type of failure expected during fatigue testing. Design changes were made to correct the failures, and retrofit changes were used to complete the test.

Flight test results showed that the loads that were projected analytically and used during the fatigue test were greater than the actual loads encountered during flight. The flight measured loads were incorporated into the second lifetime of fatigue testing which commenced June 10, 1981. As of November 5, 1981, this test article had logged approximately 10,000 hours. Since the start of the second lifetime of testing, some failures, considered minor by the Navy, have occurred, but none have been bulkhead related.

A third life-cycle fatigue test is scheduled which will test a new lightweight center fuselage, modified bulkheads, and a modified wing that incorporates the roll-rate changes. The Navy plans to complete the test of these changes around the end of 1984.

Full cell leakage

By far the most serious fuel cell leakage problem has been fuel cell number 4. The problems with fuel cell number 4 were attributed to the difficulty in producing acceptable fuel cells as well as the complexity and difficulty of installing the cell. According to Navy and contractor officials, the problems with fuel cell number 4 have been solved. There has been only one number 4 cell failure since October 1980. Before October 1980, 18 number 4 fuel cells were replaced on 5 aircraft. The corrective actions included manufacturing a more durable cell from a heavier rubberized material, developing more stringent acceptance test procedures, and improving processing techniques and quality control procedures. The Navy expects that these actions will result in significantly better reliability and will substantially reduce aircraft maintenance hours. As a backup, the Navy had a competitive contractor design and build a cell. This alternative fuel cell is currently being tested.

In addition to the problems with fuel cell number 4, the F/A-18 has experienced leaks in fuel cell numbers 2 and 3. The problems with these fuel cells are caused by the self-sealing material which is in the lining of the cells. The self-sealant material is activated when it comes into contact with fuel to

seal leaks caused by shell fragments in combat. This provides the pilot with the capability of getting home, even if receiving battle damage in the fuel system.

The current problem is due to very small holes in the cell innerliner which results in the self-sealing material coming into contact with the fuel and being activated. The self-sealant, over a period of weeks or months, expands until it destroys the cell by causing a weak point in the laminations.

According to Navy officials, the causes of the small holes in these fuel cells were damage inflicted during installation of a baffle in the fuel tank and deficiencies in the vendor's manufacturing process and procedures. The primary cause appeared to be the baffle installation. According to Navy and contractor officials, corrective actions to improve the installation of the baffle and the manufacturer's quality assurance procedures have been made and each aircraft is now tested before Navy acceptance to be sure there are no fuel cell leaks.

Oil temperature

In our prior reports, we stated that oil temperatures in the hydraulic systems and in the airframe mounted accessory drive approached or exceeded critical levels. The oil in these systems is cooled by circulation through the aircraft's fuel supply, so the problem is more acute during low fuel states. The Navy was concerned about the effect of high oil temperatures on the life and performance of parts and subsystems in the aircraft.

A number of solutions were proposed to correct the high oil temperature problem. The Navy decided the current system, a passive configuration, could be modified to provide adequate cooling by adding a fuel/air heat exchanger on the center fuselage missile fairings. Flight test data indicate that the oil temperature problem has been corrected. The improved system is to be incorporated into production aircraft next year and will be retrofitted to all limited production aircraft.

TECHNICAL PROBLEMS REQUIRING FURTHER TESTING

Although progress has been made, development and testing is still required to correct other problems, such as the

--radar,

--flight control system,

--mission computer,

--built-in test,

--air turbine starter, and

--environmental control system.

Radar software development continues to lag

Radar software development is considered by the Navy to be generally complete in accordance with the February 1982 schedule. According to Navy officials, limited additional development is needed to correct some integration deficiencies and complete all radar modes, but reduced funds will delay the development until next year. These officials believe that the radar is sufficiently complete to conduct the final operational evaluations.

Flight control system software development improved

We reported last year that software development for the flight control system was behind schedule. This happened because work to develop the flight control software was much greater than anticipated. Currently, contractors' efforts are to complete and test a production flight control system before the last Navy Preliminary Evaluation, scheduled to begin February 1982. The production prototype flight control system was flight tested on November 3, 1981.

According to a Navy official, retesting of some F/A-18 flight control qualities with the production flight control system is required to ensure that software changes correct all deficiencies discovered during development.

Built-in test function has improved

Navy and contractor officials believe the F/A-18's built-in test function is much improved. The built-in test was designed to present advisories and cautions to the pilot on the cockpit displays and to store test information which could be viewed on the maintenance monitor panel located in the aircraft's nose wheel well. The test information should appear on the monitor only if the aircraft equipment has failed, performance parameters are exceeded, or consumables need replenishment. The F/A-18's maintenance concept requires maintenance personnel to check the maintenance monitor panel before performing maintenance on components equipped with built-in test. If no information appears on the maintenance monitor panel, then the aircraft is supposed to be operationally ready with no maintenance required.

All maintenance monitor panel codes were required by contract to be available and functional in the physical configuration audit aircraft. However, a few problems still exist with some equipment items, such as the radar and radio, but these problems are reportedly being corrected.

Contractor officials said optimization of built-in test detection tolerances during ground and flight tests resulted in reduced false alarms and better fault detection. Also, the development of built-in test logic inspection provided a more detailed location of a flight control system failure. These changes resulted in an overall improvement of the built-in test. Contractor officials said current flights on F/A-18 aircraft disclosed few problems with built-in test. Also, fleet maintenance personnel are effectively using built-in test to maintain aircraft.

In August 1981 the Navy instituted a plan to assess the effectiveness of built-in test in production aircraft. According to the Navy, special emphasis is to be placed on assessment in a fleet environment, since it is there that the final measure of operational built-in test effectiveness must be made. The assessment is to be completed in August 1982.

Redesigned air turbine starter still below reliability goal

There is a continuing problem with the reliability of the air turbine starter, which is a component of the secondary power system. It powers the airframe mounted accessory drive and is used to start the F404 engines, both on the ground and as a backup system in the air.

According to contractor officials, the short lifetime problem of the air turbine starter is under control through a redesign of the starter. Testing of the redesigned starter has not yet been completed and its durability not proven. As of October 1981, over 2,800 hours of testing had been completed on the new starter, with a mean-time-between-failure of 1,204 hours. This compares with the starter's reliability goal of 7,800 hours.

Navy and contractor officials indicated the preliminary data on the redesigned system is encouraging, since the actual life of starters being used in the F/A-18 had been as low as 55 hours.

Environmental control system has limited expansion capability

The environmental control system provides air-conditioning to the cockpit and the avionics equipment. According to the Navy, the present system is sufficient to meet cooling requirements to the cockpit and avionic equipment, and to provide for some future growth. However, a Navy evaluation of the requirements for future F/A-18 advanced avionic systems, such as the airborne self-protection jammer, indicated a need for additional cooling capacity. In 1980 the Navy requested a contractor proposal for modifying the environmental control system to provide this additional capacity. A contractor request for proposal to a sub-

contractor showed the modified system should provide sufficient cooling for the F/A-18, with capacity available for known requirements through the 1980s. The additional cooling capacity may be adequate for the presently envisioned limited reconnaissance version of the F/A-18, but excess capability for future requirements is minimal.

SOME TECHNICAL DEFICIENCIES BEING ACCEPTED

Deficiencies in range and single rate of climb were not considered detrimental to F/A-18 mission effectiveness by the Navy, and no corrections are planned.

Range

According to a Department of Defense task force that reviewed the F/A-18 program, the range of the F/A-18 is acceptable. The latest range estimate by the Navy shows that the F/A-18 in the fighter configuration is about 5 percent below the Navy's established threshold. The F/A-18 appears to meet the range threshold in the attack profile.

A Navy Preliminary Evaluation held in September and October 1980 showed the F/A-18's fighter escort range was 22 percent below the development contract goal. According to a Navy official, the reason for the large difference in range was due to the flight profile that the aircraft was tested against. Navy and contractor officials stated this profile was not compatible with the flying qualities of the F/A-18 nor with how the aircraft would be used in combat. Both Navy and contractor officials believed that judging the range of the aircraft based on mission-oriented ground rules provides a more representative view of the aircraft's range capability.

In subsequent discussions with Navy officials, they said that the evaluation aircraft did not have modifications designed to improve F/A-18 range performance. They believed that with these modifications--programing deflection of leading and trailing edge flaps, filling the leading edge extension slots, increasing the radius of the leading edge flaps, and reducing projections that interrupt the flow of air around the aircraft--the F/A-18 would come very close to meeting fighter range goals.

Single engine rate-of-climb

A Navy Preliminary Evaluation concluded that the single engine rate-of-climb with full flaps and intermediate power was not adequate in a waveoff situation during a shipboard approach. The lack of single engine rate-of-climb capability with intermediate power degrades flight safety following engine failure during a carrier approach.

Navy officials said that the F/A-18 meets the single engine rate-of-climb specification in afterburner. They were confident, based on their experience as operational pilots in other Navy aircraft, that this would be acceptable for the carrier waveoff situation.

CONCLUSIONS

Work to resolve technical problems continues. A number of problems that were reported last year appear to be under control; however, operational testing is still needed to verify that the proposed improvements do correct those technical problems.

The present environmental control system provides sufficient cooling to the cockpit and avionics equipment. However, future advanced avionic systems will require additional cooling capacity above the aircraft's present capability. Time and resources are needed to expand the aircraft's cooling capacity to be able to meet future systems' requirements.

CHAPTER 5

F/A-18 PROGRAM COST CONTINUES TO BE A CONCERN

In March 1981 the Navy reported a $2.6 billion decrease in program cost, even though there are strong indications that costs will increase in the future. The major reason for the decrease was the use of lower escalation rates prescribed by the Office of Management and Budget (OMB). Meanwhile, aerospace industry escalation rate projections remain higher than those used in the current Navy estimate.

Contractor costs continue to be above their estimates. The major contractors are exceeding their planned manufacturing hours. Costs to correct problems have been more than estimated, and development of support equipment has been more costly than expected. Also, indications that subcontractors sustained losses under fixed-price contracts suggest future subcontract cost growth.

There are several measures available that could reduce cost--foreign sales, elimination of Board of Inspection and Survey Trials, deletion of mission-essential equipment from trainer aircraft, and the increased use of competitive procurement.

F/A-18 PROGRAM COST

The F/A-18 program still remains the Navy's largest aircraft program in total funding and production quantities. In February 1981 we reported that the Navy's September 30, 1980, estimate of F/A-18 program cost was $29.7 billion. In December 31, 1980, when the Navy revised the F/A-18 program to reflect fiscal year 1982 budget submission decisions, the Navy increased its estimate to $37.9 billion, but the Office of the Secretary of Defense's Program Analysis and Evaluation Directorate estimated that program cost could be as high as $41 billion. By March 1981 the Navy had again revised the program estimate and reported the estimated program costs at $35.3 billion. This estimate remained the same as of September 30, 1981. The last $2.6 billion decrease in program cost was due to the use of OMB-projected lower escalation rates.

Production quantity remains at 1,366

The number of F/A-18s were expected to decrease and the unit cost to increase if the Department of Defense decided to produce 336 AV-8B Harrier aircraft to meet the U.S. Marine Corps' close-air-support requirements. However, the planned procurement quantity of 1,366 F/A-18s has not changed. The Navy, in maintaining the 1,366 procurement quantity, revised the F/A-18 deployment plan to incorporate programed increases in carrier battle groups and to initiate introduction of F/A-18s into Navy Reserve squadrons.

Low inflation rates understate costs

The Navy is required to use escalation rates prescribed by OMB. Since mid-1978, the prescribed rates have been lower than actual inflation experienced in the aerospace industry and consequently have resulted in inaccurate estimates of the F/A-18 program cost.

Current OMB-prescribed inflation rates are, in our opinion, too low to keep pace with the steady increase in the aerospace industry. The resultant underestimated program budget may, as in other similar cases, result in reducing planned annual production quantities, thereby stretching the program. By stretching the program into the future, program costs are increased due to the additional years of inflation.

Cost growth

McDonnell and Northrop both experienced cost growth. McDonnell's pilot and limited production costs (including Northrop's costs) increased $148 million from the contract baseline of $1,125 million, or 13 percent.

A major area where cost increases occurred was in the hours required to manufacture F/A-18s. The hours required by both McDonnell and Northrop continue to exceed their estimates. This resulted in cost increases in the full-scale development as well as the pilot and limited production contracts.

According to Navy officials, current program cost estimates include provisions for higher contractor costs in the above areas.

Further cost increases are also expected in the area of support equipment. Contractors responsible for developing the automatic test equipment estimated cost overruns of approximately $28 million on the initial contracts, while estimates of over $20 million in cost overruns are indicated in the initial pilot trainer contracts.

F/A-18 COST REDUCTION PROGRAM

The Navy is considering several cost reduction initiatives which they believe could result in a net estimated cost savings of $1.2 billion to $4.6 billion. The possible cost reduction initiatives include breakout of contractor-furnished equipment, second sourcing, multiyear procurement, economic initiatives, and production or technology modernization. As of November 1981, most of these initiatives were still being discussed, and little, if any, savings had been accomplished.

Breakout of contractor-furnished equipment and second sourcing

Breakout of contractor-furnished equipment to Government-furnished equipment could result in cost savings by eliminating some administrative expense. Although implementation of breakout promises large savings, there are numerous constraints, such as system maturity and design stability; schedule, performance, and quality liability; ability to maintain adequate configuration control; and potential contractor claims for late or defective Government-furnished equipment.

Second sourcing can reduce cost by introducing competition through having two or more companies produce the same items. However, substantial front-end investment may be required.

Multiyear procurement

Multiyear procurement could result in savings in unit cost due to improved economies and efficiencies in the production processes, economy-of-scale lot buying, decreased financial borrowing costs, better use of industrial facilities, and reduction in administrative burden. According to the Navy, the F/A-18 is a candidate for multiyear procurement of the airframe starting in fiscal year 1985 and the engine in fiscal year 1984.

Economic initiatives

Economic initiatives include maximum progress payments, spares-acquisition-integrated-with-production, and economic production rates. For example, the Department of Defense recently agreed to use the spares-acquisition-integrated-with-production concept in the F/A-18 program and estimated the savings to be between $250 and $330 million. To achieve benefits from spares-integrated-with-production, long-lead spares funding concurrent with long-lead production funding is required. According to program officials, the Aviation Supply Office and McDonnell are currently discussing a spares-acquisition-integrated-with-production procedure beginning with fiscal year 1982.

Production modernization

Production or technology modernization can reduce cost by improving productivity through increasing a contractor's technological base and increasing manufacturing productivity. However, production modernization requires large initial investment to produce significant savings over the long term.

MEASURES WHICH HAVE OR COULD REDUCE COST

We believe there are additional measures available to reduce cost, such as foreign sales, elimination of Board of Inspection

and Survey Trials, deletion of mission-essential equipment from trainer aircraft, and increased use of competitive procurement.

Foreign sales assist in lowering cost

A number of foreign countries are expressing varying degrees of interest in purchasing the F/A-18. Canada has already contracted to purchase 138 F/A-18s. Also, Australia selected the F/A-18 as its new fighter to replace their Mirage III aircraft. Australia plans to purchase 75 F/A-18s.

The Canadian purchase of the F/A-18 has resulted in the Navy decreasing the program cost by approximately $1 billion, with additional decreases expected when the Australian purchase is completed. Subsequent foreign purchases of the F/A-18 could result in recouping development cost and lowering unit production costs.

Reduce costs by eliminating
Bureau of Inspection and Survey Trials

To reduce cost and shorten the development time, the Navy initiated a participatory flight test program. By having Navy test pilots participate in development flights with the contractor, they believed they could fulfill the test requirements while the number of flights was reduced. Navy officials recognized that some contractor demonstrations would not be verified. Navy officials estimated that following this plan would save 5 months' worth of testing and $8.5 million.

The Board of Inspection and Survey Trials are a formal technical evaluation for the specific purpose of identifying whether or not the aircraft meets contract technical specifications. Although trials were to have been conducted before the F/A-18 fighter Defense Systems Acquisition Review Council III (production decision evaluation), they were postponed and combined with the later F/A-18 attack trials. The Navy and the Council apparently did not consider the results of the Board of Inspection and Survey Trials to be essential when they determined that the F/A-18 was operationally acceptable as a fighter aircraft and recommended a production decision. The Secretary of Defense accepted the recommendation and directed production of the F/A-18.

This production decision, although technically only for the F/A-18 fighter, deemphasized the production decision for the attack version, since the two versions are but one aircraft with only different external equipment and ordnance denoting its mission. It would appear that value derived from the Board of Inspection and Survey Trials would have come before the F/A-18 fighter production decision rather than after almost 100 F/A-18s have been purchased.

The Navy acknowledges that all of these tests are not essential. According to a Navy official, if the fiscal year 1982 Research, Development, Testing, and Evaluation funds are

insufficient to support all test requirements, the Board of Inspection and Survey Trials would be a candidate for elimination from the fiscal year 1982 testing program. The trials are estimated to cost about $8 million. Subsequent discussions with the official following receipt of their appropriations disclosed that the Navy had decided to allocate about $2.3 million for the Board of Inspection and Survey Trials.

Competition could reduce F/A-18 cost

Development of F/A-18 test program sets had cost growth to such a point that the contractor's projected cost to design, develop, and procure test program sets was above what the Navy considered reasonable. As a result, the Navy is considering using competitive procurement for the design and development of some test program sets. The Navy estimated that competitive procurement of these sets will reduce cost of F/A-18 test program sets by over $70 million without adversely affecting performance capability or schedule. Also, the use of competitive procurement may result in reducing future costs associated with the design and development of other test program sets the Navy may require.

Deletion of mission-essential equipment from training

Significant savings can be achieved if F/A-18 mission-essential equipment, such as the radar, mission computer, self-protection jammer, and gun system, were deleted from some training aircraft. For many aspects of training, aircraft do not need mission equipment. For example, a pilot will take a number of flights to become familiar with the aircraft. In these familarization flights, mission-essential equipment will not be required. Depending upon the proposed training programs, over one-third of all training flights will not need a fully mission-equipped aircraft.

Installation of equipment if it would be needed would be no problem. Because the F/A-18 was designed to be easily maintained, most of the aircraft's subsystems were designed for ease of replacement and can be quickly installed. For example, the F/A-18's radar can be removed and replaced in a little over 12 minutes.

Deletion of mission-essential equipment from aircraft used for training could result in substantial savings. The Navy currently plans to train F/A-18 pilots at two training facilities. Together these facilities will operate between 105 and 125 F/A-18s. Almost one-half of these aircraft will be two-seat versions specifically designed for training. Fully mission-equipped aircraft are not needed for over one-third of the flights. Consequently, about 35 to 40 aircraft at the two training commands hypothetically will not need to be fully mission equipped. If just 40 radars are deleted, at a unit radar cost of $1.25 million, the Navy could save $50 million.

Also, training aircraft will be needed for a proposed Marine Corps' F/A-18 training facility. More savings could be realized if other mission-essential equipment were deleted from these training aircraft. Further, maintenance and spares requirements will be reduced for these aircraft, resulting in additional monetary savings and increased training command aircraft availability.

CONCLUSIONS

The F/A-18's estimated program cost, although lowered over the last year by the Navy, is of continuing concern to many involved with the program. There are indications that program cost will increase, such as higher-than-estimated inflation rates and contractor's manufacturing hours continuing at higher-than-estimated levels. In an effort to counter rising program cost, the Navy identified a number of cost reduction initiatives that could produce considerable savings if implemented. The Navy's cost reduction program in several areas appears difficult to implement, progress appears slow, and results seem questionable. Significant funding early in the program is required to carry out some of the initiatives.

However, cost reductions are available in other areas. Foreign sales of the F/A-18 have already reduced the cost of the program. Also, deletion of mission-essential equipment on training aircraft, further attempts to procure on a competitive basis, and elimination of the Board of Inspection and Survey Trials could also further reduce cost.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct the Navy to:

--Accelerate implementation of the Navy proposed cost reduction initiatives estimated to save $1.2 to $4.6 billion.

--Determine the value to be derived from the Board of Inspection and Survey Trials. Unnecessary redundancy between the Trials and testing already accomplished should be eliminated.

--Delete, to the extent possible, mission-essential equipment from training aircraft, thereby saving substantial procurement (as well as maintenance) cost. For example, if just 40 fewer radars were procured, the Navy could save $50 million.

--Implement competitive procurement of test program sets for an estimated savings of $70 million and explore other situations where competition could be used.

VIEWS OF AGENCY OFFICIALS

According to the Navy, the deletion of mission-essential equipment from training aircraft would not be feasible or effective for a number of reasons, including

--problems in scheduling aircraft for training missions,

--adverse psychological impact of flying less than complete aircraft,

--having mission equipment enhances training in nonmission areas, and

--need to have combat-capable training aircraft available for deployment as fleet replacement aircraft.

The above reasons merit consideration, but when funds are tight, any potential for cost reduction should be carefully considered. We feel aircraft scheduling problems can be minimized due to the projected ease in which the aircraft can be maintained. The value of operating specific mission-essential equipment during flights where the equipment is not used for training objectives does not appear to be cost effective. Furthermore, there is no combat requirement for the two-seat F/A-18s; thus, these aircraft would not be deployed as replacement aircraft.

The acceptance of the proposed concept is demonstrated in the Marine Corps' contemplated TAV-8B Harrier II trainer. In this case, with cost a major consideration, the Marine Corps elected to not include mission-essential equipment on the trainer, but rather will use operational Harriers for mission training.

APPENDIX I

OUR PRIOR REPORTS ON THE F/A-18 PROGRAM

"F/A-18 Naval Strike Fighter: Progress Has Been Made But Problems and Concerns Continue" (MASAD-81-3, Feb. 18, 1981).

"Operational and Support Costs of the Navy's F/A-18 Can Be Substantially Reduced" (LCD-80-65, June 6, 1980).

"F/A-18 Naval Strike Fighter: Its Effectiveness Is Uncertain" (PSAD-80-24, Feb. 14, 1980).

"Need to Demonstrate F-18 Naval Strike Fighter Weapon System Effectiveness Before Large-Scale Production" (PSAD-79-25, Feb. 27, 1979).

(951614)

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE,$300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS